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THE THEORY OF HEAT EXCHANGE BETWEEN CASTING AND FORM: SELECTION OF THE OPTIMUM WALL THICKNESS OF THE METAL MOLD

/The following information was taken from an article by A. I. Veynik, Chair of Thermotechnics, Moscow Aviation Technical Institute, submitted 14 May 1949. The author was assisted by A. A. Gukhman.7

Introduction

The author notes that the phenomenon of heat exchange between the hardening casting and the mold form is too complicated to study mathematically. However, he states, the wide use of the crystallization process in metal molds and the many practical problems of heat conduction in the casting, mold, and gap between them forces one, with the aid of a suitable schematic phenomenon, to solve those individual problems of heat conduction of greatest practical interest. In the present article the author solves by an approximate method the partial problem of nonstationary heat conduction in a metal mold; as a result, he finds the optimum thicknesses of mold walls.

Maximum Depth of Heat Penetration in the Mold's Wall for Castings of the Spherical Type

The author discusses the temperature distribution in the mold's wall at the moment of removal of the casting.

He determines formulas and graph describing subject depth ($X_2 = 0$ to 0.5 meter) versus temperature difference ($t_2 - t_1$: 0 to 600°C, where t_2 is the temperature of the inner surface of the mold's wall at the moment of removal of the casting and t_1 is the mean initial temperature of the mold).

Maximum Depth of Heat Penetration in the Mold's Wall for Castings of the Cylindrical Type

It is found that the thickness in cylindrical molds is considerably larger than in spherical ones.

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Maximum Depth in the Case of Flat Castings

It is found that the thickness of the wall of flat molds is greater than the thickness of the wall of cylindrical molds.

Optimum Wall Thickness of Metal Molds

The author relates k, X_1, X_2, L where X_1 is the wall thickness of the casting, X_2, the sought-for wall thickness of the mold, K the correct factor (related thus: $L = kX_2$), and L the optimum thickness.

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